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Defining and understanding "small projects" in the industrial construction sector

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Abstract

To date, little research has been performed regarding the planning and management of "small" projects – those projects typically differentiated from "large" projects due to having lower costs. In 2013, The Construction Industry Institute (CII) set out to develop a front end planning tool that will provide practitioners with a standardized process for planning small projects in the industrial sector. The research team determined that data should be sought from industry regarding small industrial projects to ensure applicability, effectiveness and validity of the new tool. The team developed and administered a survey to determine (1) the prevalence of small projects, (2) the planning processes currently in use for small projects, and (3) current metrics used by industry to differentiate between small and large projects. The survey data showed that small projects make up a majority of projects completed in the industrial sector, planning of these projects varies greatly across the industry, and the metrics posed in the survey were mostly not appropriate for use in differentiating between small and large projects. This study contributes to knowledge through adding to the limited research surrounding small projects, and suggesting future research regarding using measures of project complexity to differentiate between small and large projects.

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1. Introduction

Poor scope definition has been shown to be one of the major factors leading to poor project performance [1]. Many construction experts believe that planning efforts conducted during the early stages of a project (e.g., preproject planning or front end planning) have a significantly greater effect on project success than those undertaken after the project has begun.

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Discrete tasks can be identified and organized in a structured manner to provide a standardized front end planning process [2]. Since 1991, the Construction Industry Institute (CII) has created a suite of tools to be used to define project scope and assess the level of planning readiness during preconstruction. These Project Definition Rating Index (PDRI) tools consist of specific elements that should be considered prior to the beginning of detailed project design, and have been developed separately for industrial, building, and infrastructure projects. Through the development of each tool, validation has shown that planning assessments using the PDRI consistently provide projects with improved cost, schedule and change order performance [1,3,4,5].

Though effective in the planning of large construction projects, the PDRI's were not developed or validated on small projects. CII tasked Research Team 314 with developing a PDRI tool specifically for small industrial projects in the summer of 2013. Small projects were deemed to be a significant portion of completed work across the industrial sector, including projects in oil/gas production facilities and refineries, chemical plants, manufacturing facilities, and electrical generation facilities to name a few. A thorough understanding of what constitutes a small project and their prevalence in the industrial sector was paramount for the research team to ensure applicability, effectiveness and validity of the new tool. This paper describes the first steps of this multi-part research project, namely the literature review and survey completed by the research team that sought to provide a definition of "small project", and discern the prevalence of these types of projects in the industrial construction sector.

2. Defining small projects

While numerous authors have published definitions for "small project," the literature does not yet support a consensus. Westney (1985) defined a project as "an endeavor in which a number of tasks are performed in order to accomplish a particular objective." Projects are typically considered small when they do not involve a major investment, and are undertaken to meet certain business objectives, such as maintenance to or increase of production capacity, compliance with environmental requirements, and performance of research for new product development [6]. CII published the *Manual for Special Project Management* in 1991, and concluded that "due to the wide variations in relative size, complexity, schedule duration and cost of projects executed by an even less homogeneous cross section of owners, architects, engineers and constructors, it is impossible to acceptably define what a small project is" [7]. Griffith and Headley (1995) found a similar conclusion, that although the term 'small project' is commonly used across the construction industry, there is much diversity in the understanding of the expression [8].

The above referenced studies, along with Liang et al. (2005), stated that small projects have certain characteristics that differentiate them from large projects [9]. Table 1 below lists these characteristics, and shows the breadth in which small projects can be defined.

Table 1 – Small Project Characteristics

References	Cost	Duration	Other
Westney (1985)	$5,000 to $50 million	N/A	Numerous other projects taking place concurrently, labor and equipment resources shared with other projects
CII (1991)	$2,000-$3.5 million for engineering only, $100,000-$25 million for construction only, $100,000-$100 million for EPC	1-15 months small engineering-only projects, 1-14 months for construction only, 2-30 months for EPC	Personnel hours - 200-65,000 for engineering only, 2,500-500,000 for construction only, 1,500-750,000 for EPC, part-time management, simpler project controls
Griffith and Headley (1995)	Limited cost	1-3 months	Low complexity, limited inputs, limited formal documentation, occur in active environments
Liang *et al* (2005)	Total installed cost between $100,000 and $5 million	14 months or less	Site work hours up to 100,000, part-time project management, any level of complexity

3. Research Methodology

In reviewing previous studies and publications regarding small projects, it was evident that a clear and consistent definition of what differentiates a small project from a large project does not currently exist. The research team

determined that additional information should be sought to clarify (1) the prevalence of small projects, (2) the planning processes currently in use for small projects, and (3) current metrics used by industry to differentiate between small and large projects. A survey was developed using previous small project research as well as experience from Research Team 314 members to aid in the development of the new PDRI tool.

Survey questions were created to elicit information regarding the stated criteria. To determine the prevalence of small projects in the industrial sector, the survey included questions where respondents were asked to review all projects completed during the past fiscal year by their organization, and estimate the number of projects that would be considered small based on their organization's definition. This was to be provided as a percentage on both a count basis (i.e., 40 out of 60 projects considered small = 67%) and a cost basis (i.e., $50 million out of $100 million worth of projects considered small = 50%).

To determine what current planning processes were being used in industry for small industrial projects, seven possible processes were provided and respondents were asked to select all that applied to their organization. These processes included:

- Front end planning happens only at the program/portfolio level
- Dedicated task force for all small projects
- Internally developed scope definition tool
- Structured stage gate
- Ad-hoc
- Standardized scope package deliverables for all small projects
- None

There was also an option for "other" where respondents could specify processes that had not been identified. Respondents were asked about their previous experience in using PDRI tools, if they had used these tools specifically on small projects, or if they had modified the PDRI specifically for use on small projects.

Respondents were asked to consider 14 separate metrics (shown in Table 2) that could possibly be used to differentiate between small and large projects. Each metric had a "break point" listed that could separate small and large projects. Respondents were asked (1) if they agreed that the listed metric could be used as a differentiator between small and large projects, and (2) if they agreed with the break points listed. If the respondent agreed with the metric but disagreed with the break points that were listed, they were asked to provide the break points that they felt were appropriate. For those metrics having break points that were not numerical in nature (i.e., Impact to Operations: minimal vs. significant), respondents were asked to provide any additional comments that they had, in support of eliciting commentary regarding why or why not that metric was appropriate. Respondents were also asked to provide any other metrics that their organizations used to differentiate between small and large projects.

Table 2. Survey Matrix Listing Proposed Small Project Differentiators and Break Points

Metric	Small Projects	Large Projects
Total Installed Cost	< $10 Million	> $10 Million
Regulatory/Environmental	Minimal permitting required	Extensive permitting required
Construction Duration	< 6 Months	> 6 Months
Engineering Effort	< 5000 Hours	> 5000 Hours
Risk to Reputation	Minimal	Significant
Impact to Operations	Minimal	Significant
Visibility to Owner Management	Local/Department	Organization/Corporate
Team Expertise	Minimal special or new expertise required	Extensive special or new expertise required
Team Resources Availability	Mix of full or part-time	Dedicated full-time
Core Team Resources Numbers	1-5 individuals/firms	> 5 individuals/firms
Core Team Makeup (Engineering and Craft)	1-2 disciplines/crafts	> 2 disciplines/crafts
Experience with Project Characteristics	Repetitive or some new aspects - technology, processes	Extensive new aspects - technology, processes
Stakeholders Impacted	Internal	External
Funding Decisions	Plant/local	Corporate

As CII member organizations cover a vast cross-section of the industrial sector, the research team determined that polling individuals from these organizations could provide substantial insight into this industry's current practices regarding small projects. CII was able to provide contact information for approximately 170 practitioners from their member database that had agreed to provide data for ongoing research projects. The survey was created electronically using an online survey host, and an email was sent to each of these 'data liaisons' with a brief description of the study and a solicitation to complete the survey through a provided website link. The 20 practitioner members of Research Team 314 were asked to complete the survey as well. Each individual was asked to pass along the solicitation to any other practitioners that they felt might be interested in providing data regarding small industrial projects.

4. Survey Results

In total, 90 responses to the survey were received, approximately a 47% response rate. The survey was open for roughly a two-month period between November 2013 and January 2014. Individuals from 37 separate organizations completed the survey. Figure 1 details the breakdown of organization type between the survey respondents.

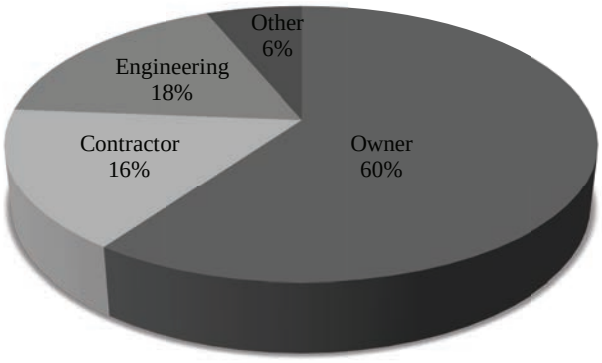

Figure 1. Organizational Breakdown of Survey Respondents

As shown, a majority of the respondents were from owner organizations. Those listing "Other" as their organization type included engineer-procure-construct (EPC) organizations, as well as operations, government, and an automation product supplier.

4.1 Small Project Prevalence

Figure 2 details the responses to prevalence of small projects completed during the past fiscal year. On a cost basis, a majority of the respondents estimated that 11-30% of the completed projects met their definition of a small project.

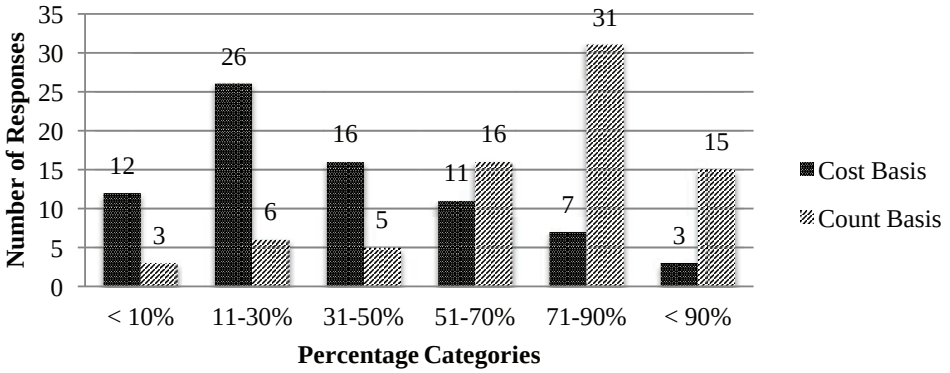

Figure 2. Prevalence of Small Projects in Survey Respondent's Organizations

On a count basis, a majority of the respondents estimated that 71-90% of the completed projects met their definition of a small project. Based on the graphical representation, it is clear that on a total cost basis the bulk of responses are skewed below the 50% mark, and on a total count basis the bulk of responses are skewed above the 50% mark. This illustrates that projects considered small are substantial in the industrial sector, making up a majority of completed projects by count, and a considerable amount of capital expenditure for construction each year.

4.2 Front End Planning Processes

Data regarding the current planning processes of respondent organizations is included in Figure 3. Answers ranged across all seven possible processes, with "internally developed scope definition tool" and " structured stage gate" being the most prevalent and receiving a nearly equal number of responses. "Other" front end planning processes included responses such as " All of the above can apply depending on specific scope and complexity", "Some of these processes are used in some instances but not for all small projects" and " For small projects, different business units have their own procedures that may or may not be consistent across all areas." Figures 2 and 3 shows that a vast majority of projects completed in the industrial sector would be considered small projects, and that the planning processes for these types of projects varies greatly across the industry. This data lends weight to the validity of creating a planning tool specifically for small industrial projects, as a standardized process for planning these types of projects could have a significant impact due to the immense applicability in the industrial sector.

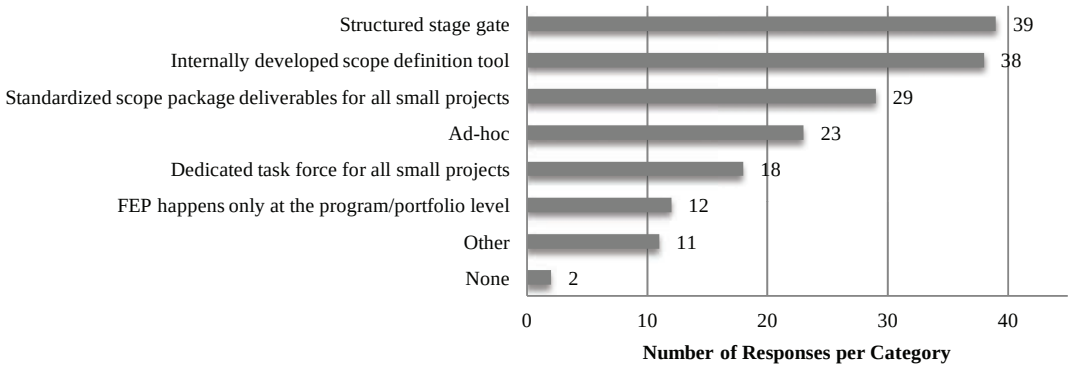

Figure 3. Front End Planning Processes for Small Projects

4.3 PDRI Usage for Planning Purposes

As shown in Figure 4, over 50% of the respondents had used the PDRI on a few selected projects, and approximately 30% use it on most projects. Figure 5 shows that PDRI usage is mostly for those projects that the respondent organizations would not consider small, as very few respondents had either used or modified the PDRI for use on small projects.

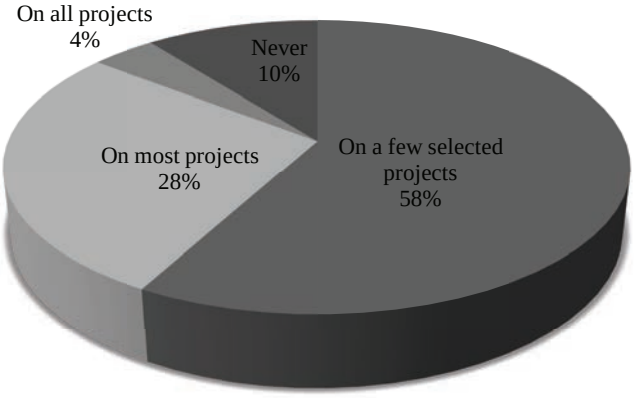

Figure 4. Survey Responses Regarding Past PDRI Usage

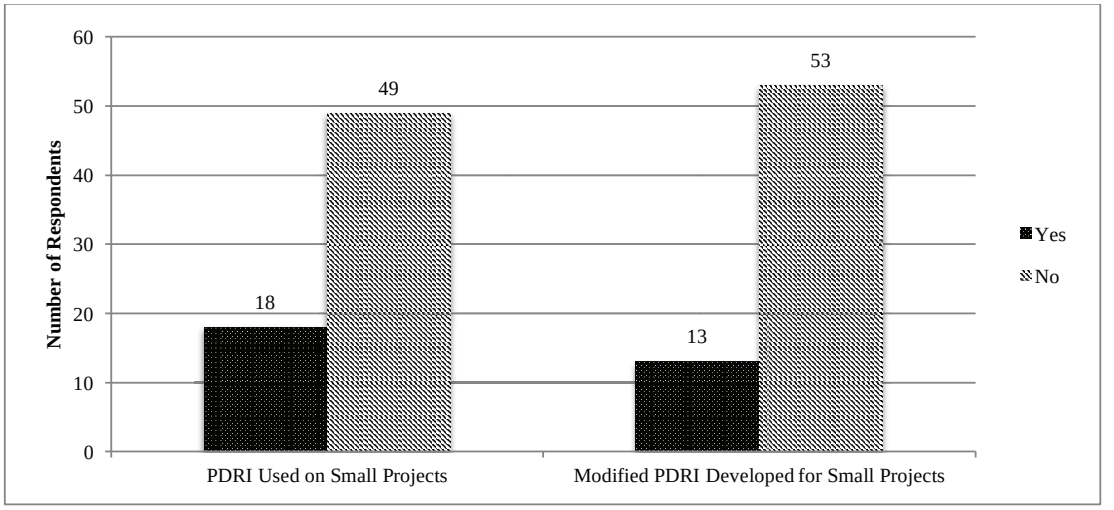

Figure 5. PDRI Usage on Small Projects

The usage of the PDRI aligns with the data provided in Figures 2 and 3 regarding the prevalence of small projects. As the majority of projects completed by the respondent organizations are of lower cost, and the planning processes for these types of projects vary greatly across the industry (and even within these organizations), it is natural that a PDRI assessment would mostly be used on a few selected projects. With the success shown in previous research regarding improved project performance with the use of PDRI tools (Bingham et al. 2011; Cho et al. 1999; Gibson & Dumont 1995; Gibson et al. 2006) this data also lends weight to the validity of creating a planning tool that is specifically for small industrial projects.

4.4 Small vs. Large Project Differentiators

Table 3 provides a summary of the total responses regarding the 14 separate metrics that the research team had identified as possible ways to differentiate between small and large projects. Out of the 14, respondents clearly agreed with only three metrics as differentiators, namely: total installed cost, construction duration, and funding decisions. Five of the metrics had total agree/disagree responses that were very close and could be considered possible differentiators: engineering effort, impact to operations, team resources availability, core team resources numbers, and experience with project characteristics. Respondents clearly disagreed with six of the metrics, including: regulatory/environmental permitting, risk to reputation, visibility to owner management, team expertise, core team makeup (engineering and craft), and stakeholders impacted. Respondents disagreed with the numerical break points of all five metrics to which these were pertinent; total installed cost, construction duration, engineering effort, core team resources numbers, and core team makeup (engineering and craft).

As shown, total installed cost is the metric most agreed upon by the survey respondents. This aligns with previous research, as well as the opinions of the research team, that cost alone is the most common differentiator in most organizations as to what is considered a small vs. a large project. The data provided by those that disagree with the $10 million break point highlights the vast difference across the industry regarding small projects. Suggested break points ranged from $200,000 to $250 million, with the most prevalent answer being $5 million dollars. With such a discrepancy across the industry, this shows that defining a specific cost as a differentiator would not be valid. Construction duration answers followed a similar logic to total installed cost. A majority of respondents agreed that this could be used to differentiate between small and large projects, but most disagreed that 6-months was an appropriate break point. Suggested break points ranged from 1-18 months, with the most common answer being 12 months. Project funding decisions for small projects being plant/local as opposed to corporate was also agreed upon, with several comments given essentially stating that projected project costs increase, so does the level of approval.

Table 3. Survey Responses to Metrics and Break Points

Metric	Agreement with Metric		Agreement with Break Point	
	Agree	Disagree	Agree	Disagree
Total Installed Cost	81	4	30	53
Regulatory/Environmental Permitting	27	56	N/A	N/A
Construction Duration	49	34	30	49
Engineering Effort	43	39	30	42
Risk to Reputation	32	49	N/A	N/A
Impact to Operations	40	40	N/A	N/A
Visibility to Owner Management	33	48	N/A	N/A
Team Expertise	23	58	N/A	N/A
Team Resources Availability	40	41	N/A	N/A
Core Team Resources Numbers	38	40	21	49
Core Team Makeup (Engineering and Craft)	30	49	17	46
Experience with Project Characteristics	40	39	N/A	N/A
Stakeholders Impacted	28	49	N/A	N/A
Funding Decisions	46	31	N/A	N/A

Several metrics that had agree/disagree responses very close to being equal provided insight that project complexity should be considered when planning for a small project. For example, the impact to operations metric (minimal vs. significant) received an equal number of agree/disagree responses. Some of the responder comments included “While not a direct metric that we would use to classify a project, this metric would definitely be an indication of level of complexity, planning and coordination that would be required for project execution”, and “Some small dollar amount projects have a high impact on the operation, so they should receive more scrutiny than just a dollar amount would indicate.” This is echoed in commentary received regarding the experience with project characteristics metric, an example being “We may have a small project in overall cost and resource requirements that could include the implementation of a new technology. This metric would be an indication of project complexity and how we would staff the project.” Respondent commentary also highlighted the fact that some of the

metrics and breakpoints listed may actually be consequences of a project being small as opposed to a differentiator between small and large projects, such as project visibility to owner management. It was suggested that, consequentially, a project might not be visible to the upper levels of management because it is small, as opposed to considering a project as being small because it has no visibility to upper management.

Metrics including regulatory/environmental permitting along with risk to reputation, team expertise, core team makeup and stakeholders impacted were all disagreed upon by a majority of the survey respondents. Commentary regarding these metrics illustrated that these items transcend project size, with remarks such as "With social media, any project can create risk to reputation regardless of project size." It was also suggested that items such as permitting and team expertise could be just as significant, if not more so, on small projects than on large projects depending on the scope of work.

5. Conclusion

The results of this survey show that small projects make up a majority of projects completed in the industrial sector, planning of these projects varies greatly across the industry, and based on industry perceptions, the metrics posed were mostly not thought to be appropriate for use in differentiating between small and large projects. As standardized front end planning processes have consistently shown to improve project success and reduce many of the typical wastes realized on construction projects, this provides great incentive to develop a tool specifically for these types of projects. This data also shows that any tool (such as the PDRI) must be applicable to a vast range of small project types and sizes if it is to be pertinent and effective for use by industry practitioners.

As shown through the literature review and survey results, due to the vast range of opinions regarding what constitutes a "small project", providing a clear-cut definition based on metrics and break points is very difficult, and maybe impossible. As there is such a significant range across the industry as to what constitutes a small project, especially project cost, all of the metrics considered in this research may be more suitably thought of as *indicators* of a project being small, as opposed to *differentiators*. Many of the survey respondent comments addressed the issue of "project complexity". Further research should focus on understanding how project complexity is defined in the realm of construction projects, and if this may be a more appropriate method to differentiate between small and large projects.

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